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Published in:
Book of Abstracts. DTU's Sustain Conference 2015

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Environmentally sustainable nanoparticles - Towards a new paradigm for ecotoxicity testing and hazard assessment of engineered nanoparticles

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For a sustainable development and use of engineered nanoparticles it is crucial that the potential environmental risks related to these are evaluated. In risk assessments of engineered nanoparticles the current practice is that the existing test guidelines for chemical risk assessment are used, though it has been realized that some technical changes may be needed. Evidence in the scientific literature is emerging that these conventional methodologies for assessing chemical risks may not be appropriate for assessing risks associated with nanomaterials.

In the project EnvNano funded by the European Research Council, we challenge the assumptions behind the use of methods developed and optimized for dissolved chemicals. Our starting point is the fact that particles behave fundamentally different than dissolved chemicals in the test systems used for risk assessment. Through a range of experimental studies of engineered nanoparticles in ecotoxicity tests with algae and crustaceans we have found that understanding and quantification of the dynamic changes occurring to engineered nanoparticles in water before and during testing may hold the key to a proper interpretation of test results obtained. Based on these findings we propose that a combination of a shortened exposure period with an aging step of engineered nanoparticles in medium prior to testing should be implemented to achieve increased control of exposures in ecotoxicity tests [1]. Results obtained for uptake and excretion of nanoparticles in freshwater crustaceans (Daphnia magna) and zebrafish underline that the principles of assuming chemical equilibrium between test species and the surrounding environment, traditionally used for dissolved chemicals, are not valid for nanoparticles [2,3].

The experimental findings in EnvNano are directly connected to the development of new risk evaluation approaches. This has so far resulted in two frameworks for alternative risk evaluation of engineered nanoparticles. Both of these are designed to operate under severe lack of data and are adaptable to including new experimental findings. The first framework is aimed at an operationalization and application of “early warning signs” to screen nanomaterials for harmful properties. It shows how the warning signs of novelty, persistency, bioaccumulation, dispersivity, and irreversible action can used as a first screening for potentially hazardous nanomaterials [4]. The second framework is a conceptual tool for categorization and communication of exposure potentials and hazards of nanomaterials in consumer products [5].

This presentation will show how the findings described above, besides contributing the fundamental knowledge base on ecotoxicological properties of engineered nanoparticles, also assist in the development of methods appropriate for evaluating the environmental risks.

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